reference label -48a- in FIG. 5 needed to be provided. Attached is a redlined drawing sheet 5/9 with FIG. 5 having a reference numeral 48a included. Applicant will provide a formal FIG. 5 upon approval of the examiner, which will also include a formal FIG. 8.

The drawings attached to the application when filed were informal. Attached please find formal drawings 1-4, 6, 7 and 9-14, incorporating the changes from applicant's October 17, 2002, response to the examiner's first office action. Please substitute these drawings for the previously filed informal drawings.

Specification

The examiner objected to the disclosure and suggested changes to the disclosure to overcome the objections. All of the examiner's suggested changes have been incorporated except one. The examiner suggested that on page 12, line 22, the word -inductance- should precede "vias". However, the vias were previously described in the specification as "conductive".

Claims

The examiner rejected claims 1-7 and 31 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as at the invention. Claim 1 has been canceled, but to the extent that its limitations are incorporated into allowable dependent claims (see below), these claims have been amended to address the examiner's concerns. The term "altering" has been amended to "alterable" to be consistent, the term "it" has been amended to "the waveguide", and "at least on pair" has been amended to "at least one pair".

35 U.S.C. 102(b)

The examiner rejected claims 1-3 as being anticipated by U.S. Patent No. 5,526,172 to Kanack. Claims 1-3 have been canceled.

The examiner also found that claims 4-7 and 31 would be allowable if rewritten in independent form to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, and to include all of the limitations of the base claim and any intervening claims.

Claim 4 has been rewritten in independent form to include the limitations of claim 1 and to overcome the examiner's 35 U.S.C. 112 rejections. Claims 5-7 depend from claim 4.

Claim 31 has also been rewritten in independent form to include the limitations of claim 1 and to overcome the examiner's 35 U.S.C. 112 rejections.

Claims 4-7 and 31 are now believed to be in proper form for allowance, and a Notice of Allowance is respectfully requested.

Respectfully submitted,

Dated: March 7, 2003

Jaye G. Heybl
Attorney for Applicants
Registration No. 42,661

KOPPEL JACOBS PATRICK & HEYBL
555 St. Charles Drive, Suite #107
Thousand Oaks, CA 91360
(805)373-0060

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Paragraph on page 3, lines 20-33:

A second impedance structure has been developed that is particularly applicable to the sidewalls and/or top and bottom walls of metal rectangular waveguides. [M. Kim et al., A Rectangular TEM Waveguide with Photonic Crystal Walls for Excitation of Quasi-Optic Amplifiers, (1999) *IEEE MTT-S*, Archived on CDROM]. Either two or four of the waveguide's walls can have this structure, depending upon the polarizations of the signal being transmitted. The structure comprises parallel conductive strips on a substrate of dielectric material. It also includes conductive vias through the sheet to a conductive layer on the substrate's surface opposite the strips. At resonant frequency, this structure presents as a series of high impedance resonant L-C circuits.

Paragraph on page 5, line 28 to page 6, line 3:

In another embodiment, the phase shifting waveguide again has an impedance structure on two or all four of its walls, with the impedance structure being voltage controlled to resonate at different frequencies. The range of resonant frequencies is below the signal frequency being passed by the waveguide, and changes in the structure's resonant frequency result in different shifts in the phase of the signal being passed. The preferred impedance structure has parallel conductive strips. To change the resonant frequency, the impedance structures include varactor diodes along the gaps between the structure's conductive strips. A change in the voltage applied to the varactor [diode] diodes changes both the capacitance across the gap and the resonant frequency of the structure.

Paragraph on page 9, lines 3-12:

With the impedance structures 12 on its sidewalls, the waveguide 10 is particularly applicable to passing vertically polarized Ev signals that have an E field transverse to the strips 18. As shown in FIG. 2, at a particular resonant frequency the vias 22 present an inductive reactance (L) 26 to the transverse E field, and the gaps between the strips 18 present an approximately equal capacitive reactance (C) 28. The surface presents parallel resonant L-C circuits 29 to the signal's transverse E field component; i.e. a high impedance.

Paragraph on page 10, lines 15-22:

Numerous materials can be used to construct the impedance structure 12. The dielectric substrate 20 can be made of many dielectric materials including, but not limited to, plastics, poly-vinyl carbonate (PVC), ceramics, or high resistance semiconductor material such as Gallium Arsenide (GaAs), all of which are commercially available. Highly conductive material should be used for the conductive [patches] strips 18, conductive layer 24 and vias 22.

Paragraph on page 12, lines 7-30:

FIG. 5 is a detailed sectional view of one of the impedance structures 42. It has alternating conductive strips 48 similar to those described above. They have uniform width and are formed on a dielectric (e.g. high resistivity GaAs) substrate 52, that can be made of the same dielectric materials as the dielectric 20 in FIG. 1. Conductive vias 54 extend from the strips, through the substrate 52 to a conductive layer 56 on the substrate's

outer surface. Control strips 48a are provided between the conductive strips 48 and have a voltage applied to them that controls the capacitance across the gaps between strips 48 and 48 a. Each control strip 48a has vias 55 extending through the dielectric substrate 52 to the conductive layer 56. Each strip comprises a conductive via cap 65 on top of its vias 55, an insulator strip 66 on top of the via cap 65, and a wider conducting voltage strip 67 on the insulating strip 65. Each gap between strips 48 and 48a have a pair of varactor (i.e. variable capacitance) diodes 58 to vary the capacitance across the gaps. Varactor diodes are junction diodes that are utilized for their voltage dependent capacitance. A conductive N+ layer 60 connects each pair of varactor diodes 58 across each gap. Along the edge of each insulating strip 66, between the voltage strip 67 and the varactor diode below, is a conductive coupling strip 68 that provides a conductive path between the voltage strip 67 and the varactor diode 58.

Paragraph on page 13, lines 13-23:

In fabricating the diodes 58, N+ layers 60 of a semiconductor material such as GaAs, are etched into mesas before the strips 48 are formed. The layer 60 runs along the gaps between the strips and will be partially below the strips 48 and 48a on each side of the gaps. The diodes 58 are then formed on the N+ layer 60, with both the N+ layer 60 and the diodes terminating short of the vias 54 and 55 and separated therefrom by intervening portions of the dielectric material. When the strips 48, insulating layer 66, coupling strip 68 and voltage strip 67 are formed, they extend over a diode 58 on each lateral side.

Paragraph on page 16, line 25 to page 17, line 5:

Matching grid polarizers 110 and 112 are mounted on each side of and parallel to the array amplifier chip [106] 108. The polarizers appear transparent to one signal polarization, while reflecting a signal with an orthogonal polarization. For example, the output grid polarizer 112 allows a signal with an output polarization to pass, while reflecting any signal with an input polarization. The input polarizer 110 allows a signal with an input polarization to pass, while reflecting any signal with an output polarization. The distance of the polarizers from the amplifier can be adjusted, allowing the polarizers to function as input and output tuners for the amplifier, with the polarizers providing the maximum benefit at a specific distance from the amplifier.

Claims

4. (Twice Amended) A rectangular waveguide for shifting the phase of a signal transmitted through the waveguide, comprising:

a waveguide comprising a top wall, a bottom wall and two sidewalls; and

at least one pair of opposing impedance wall structures, with one of said at least one pair being on said top wall and bottom wall, or said sidewalls, or both, each of said wall structures presenting an alterable surface impedance to transmitted signals of said waveguide, each of said wall structures presenting a high impedance to a resonant frequency signal transmitted by said waveguide, said surface impedance being alterable to cause the phase of said resonant frequency signal to change [The waveguide of claim 3], wherein each of said impedance wall structures comprises:

a substrate of dielectric material having two sides;

a conductive layer on one side of said dielectric material;

a plurality of mutually spaced conductive strips on the other side of said dielectric material, said strips separated by gaps and positioned parallel to said waveguide's longitudinal axis; and

a plurality of conductive vias extending through said dielectric material between said conductive layer and said conductive strips; and

a means for altering said impedance presented to said transmitted signals of said waveguide.

31. (Amended) A rectangular waveguide for shifting the phase of a signal transmitted through the waveguide, comprising:

a waveguide comprising a top wall, a bottom wall and two sidewalls; and

at least one pair of opposing impedance wall structures, with one of said at least one pair being on said top wall and bottom wall, or said sidewalls, or both, each of said wall structures presenting an alterable surface impedance to transmitted signals of said waveguide, each of said wall structures presenting a high impedance to a resonant frequency signal transmitted by said waveguide, said surface impedance being alterable to cause the phase of said resonant frequency signal to change [The waveguide of claim 1], wherein said wall structures present high impedance resonant L-C circuits to said resonant frequency, said impedance being altered to present a primarily inductive impedance to said resonant frequency.

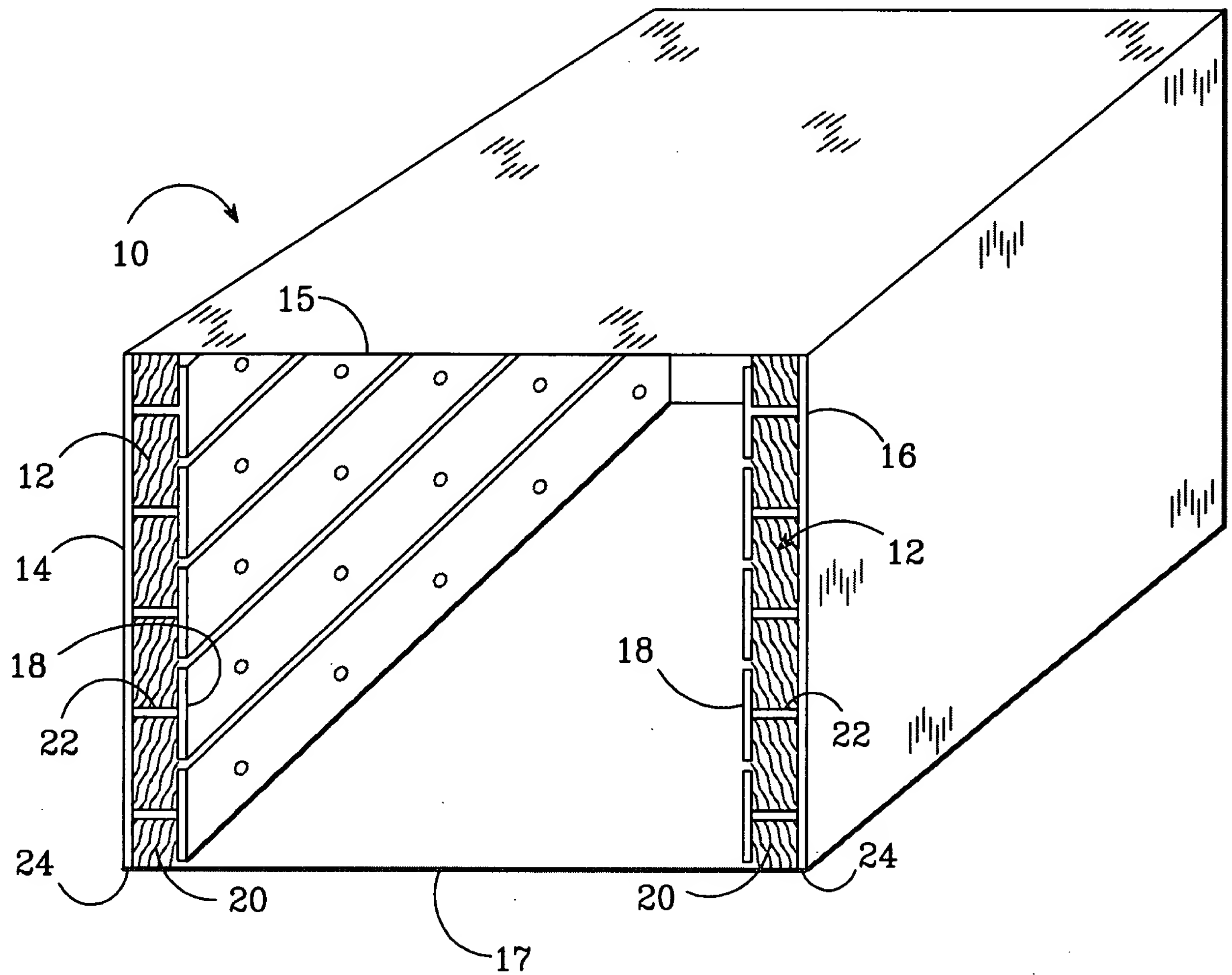

FIG.1

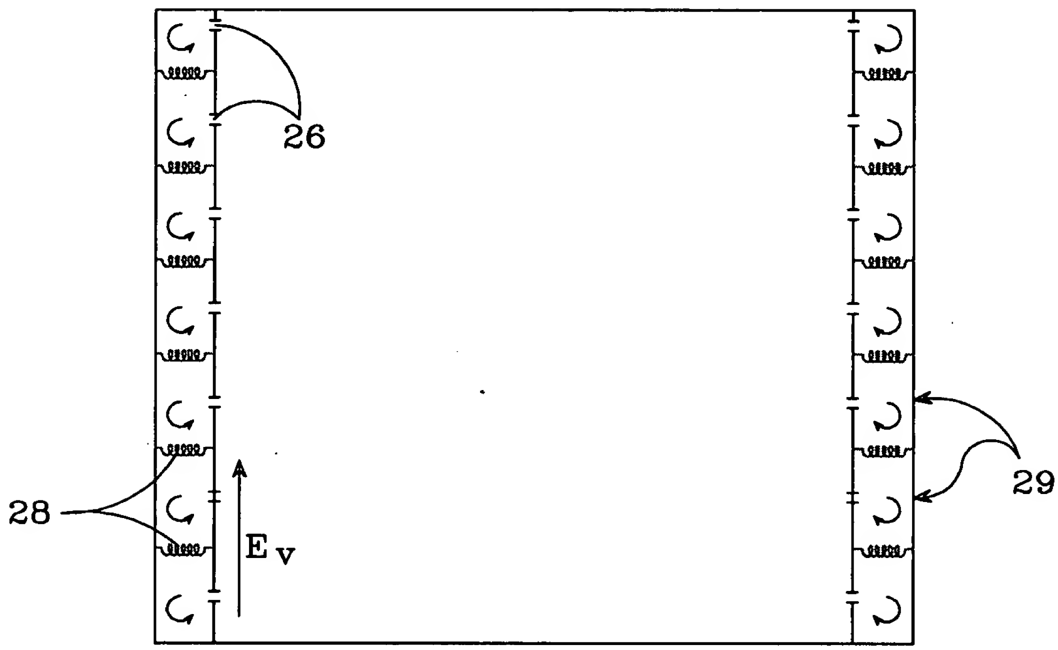

FIG.2

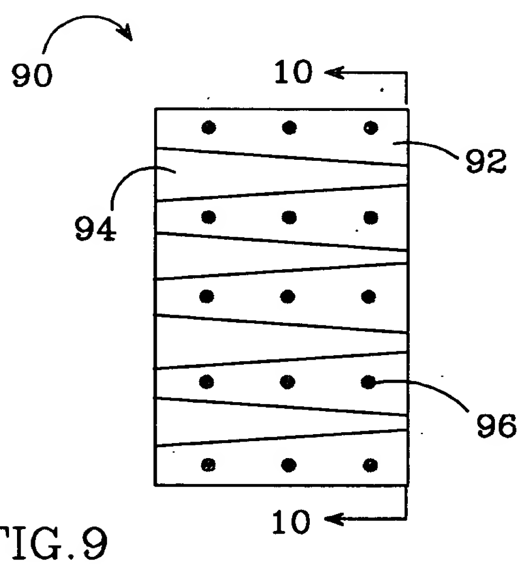

FIG.9

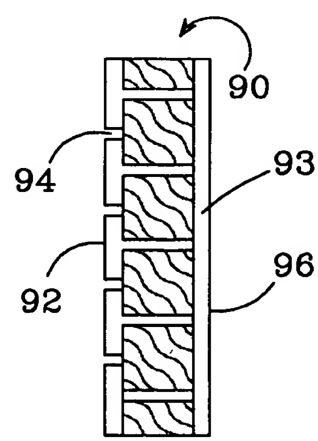

FIG.10

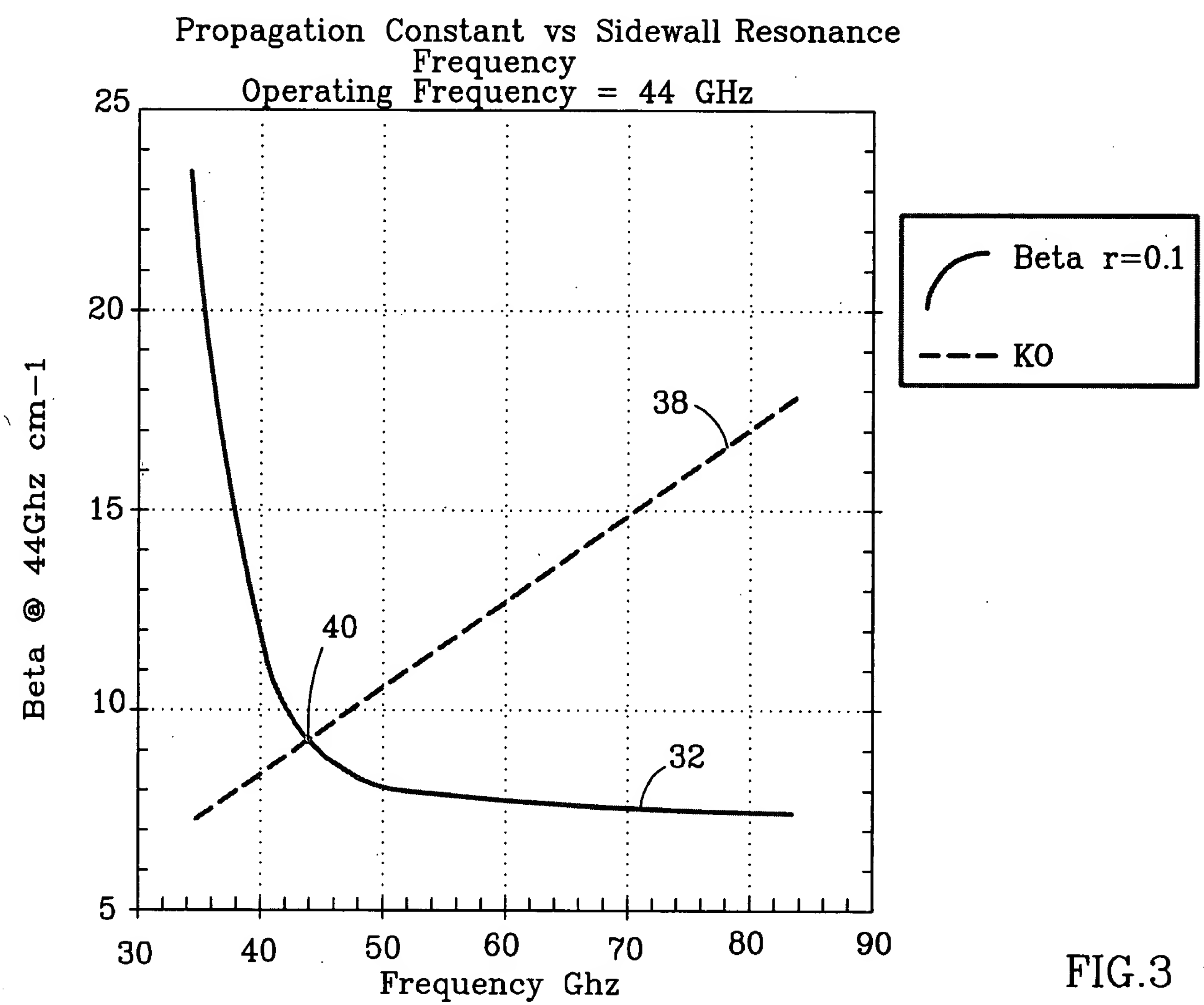
Propagation Constant vs Sidewall Resonance
Frequency
Operating Frequency = 44 GHz
25
20
15
10
5
30
40
50
60
70
80
90
Frequency Ghz
Beta @ 44Ghz cm-1
Beta r=0.1
KO
38
40
32

FIG.3

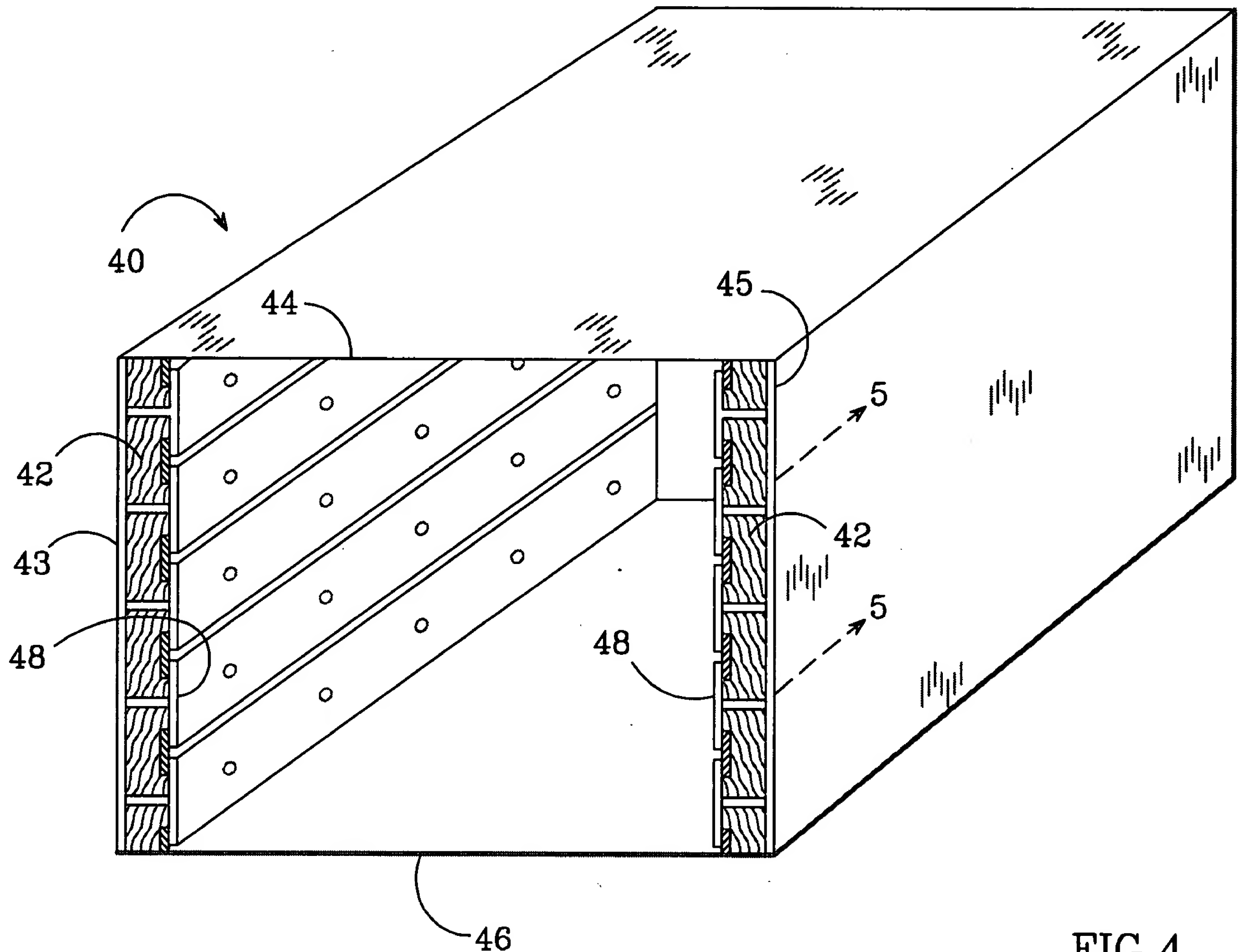

FIG.4

Approved
JB

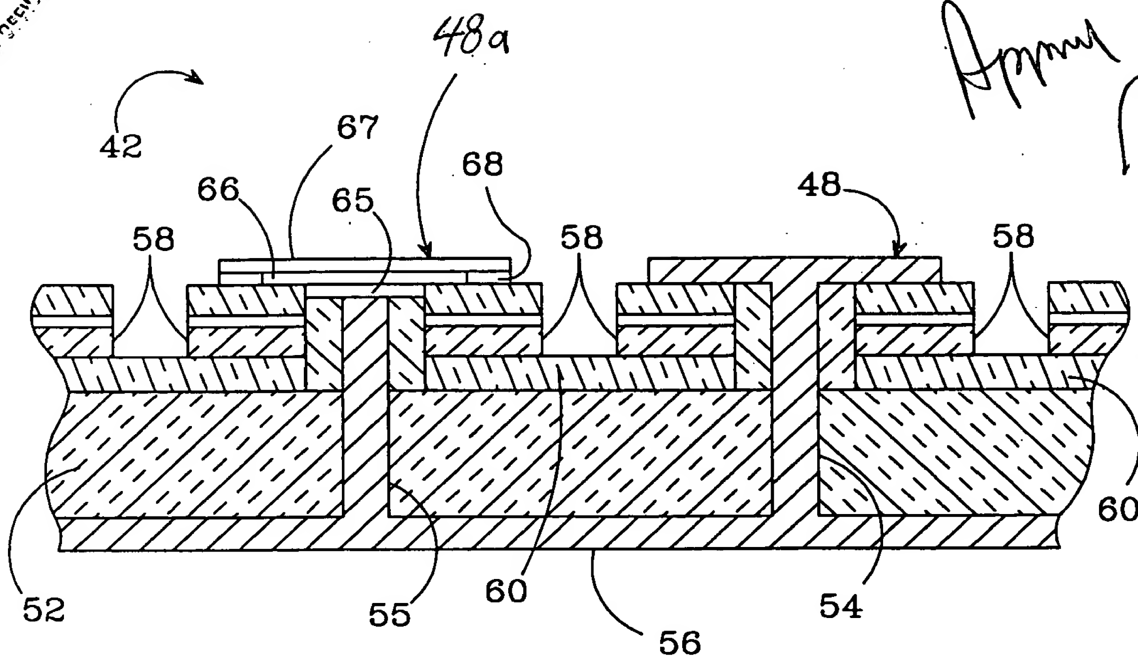

FIG.5

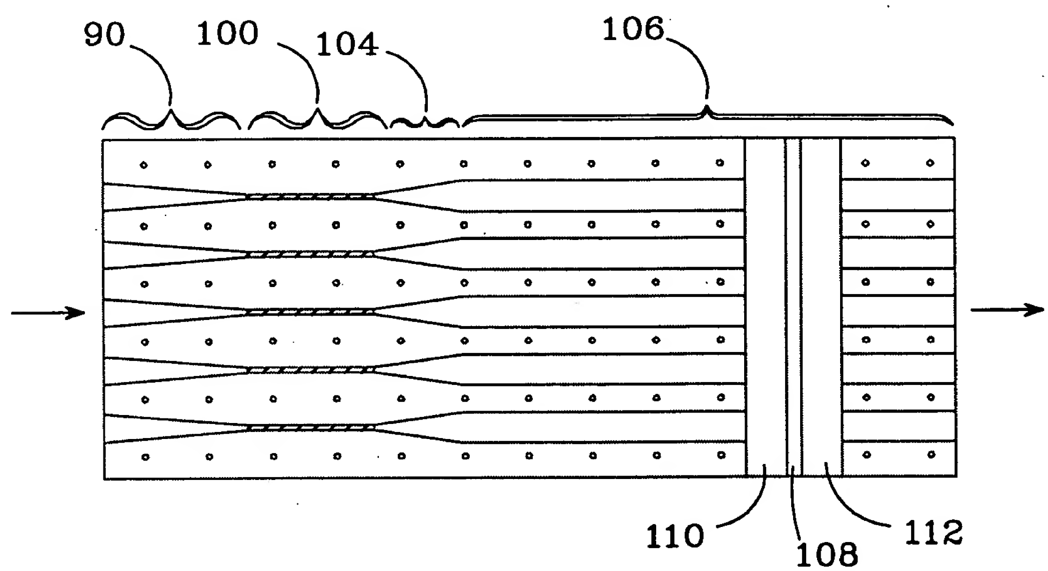

FIG.8

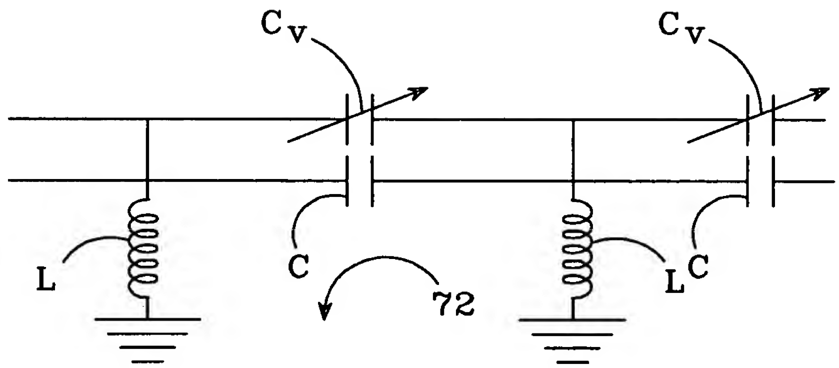

FIG.6

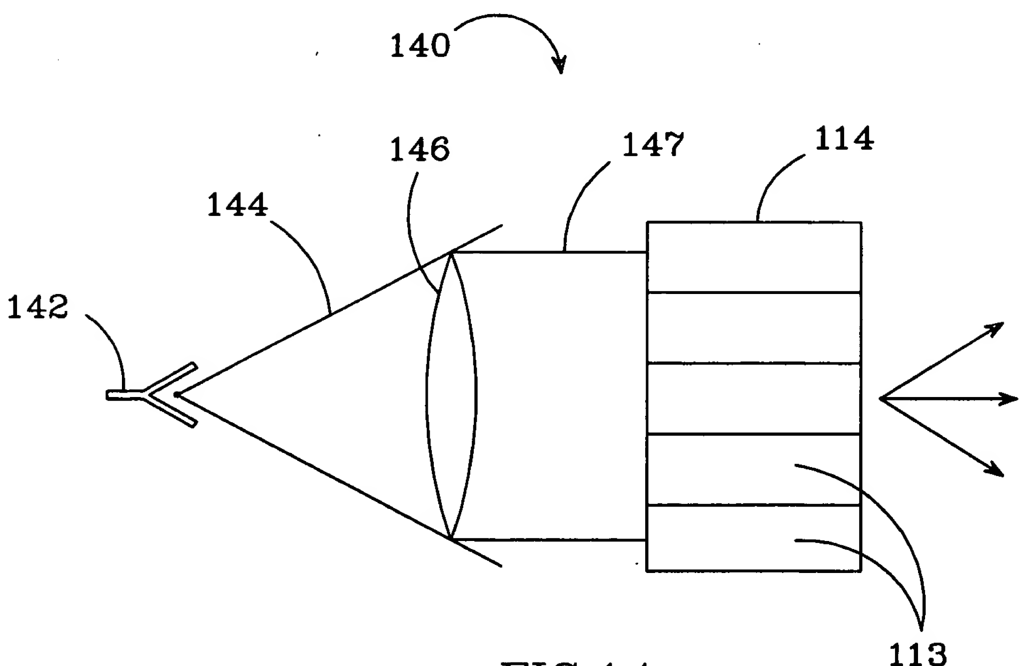

FIG.14

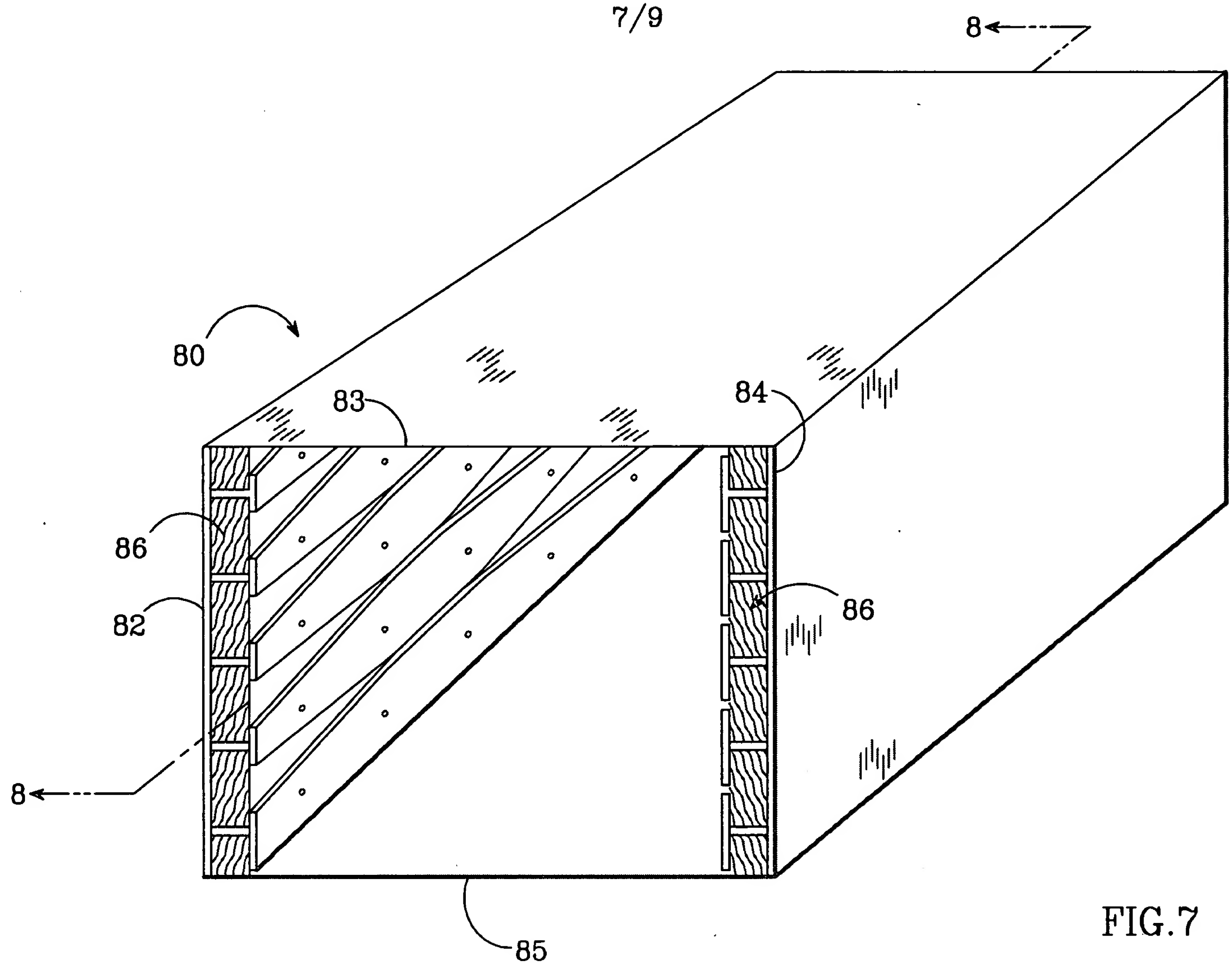

FIG.7

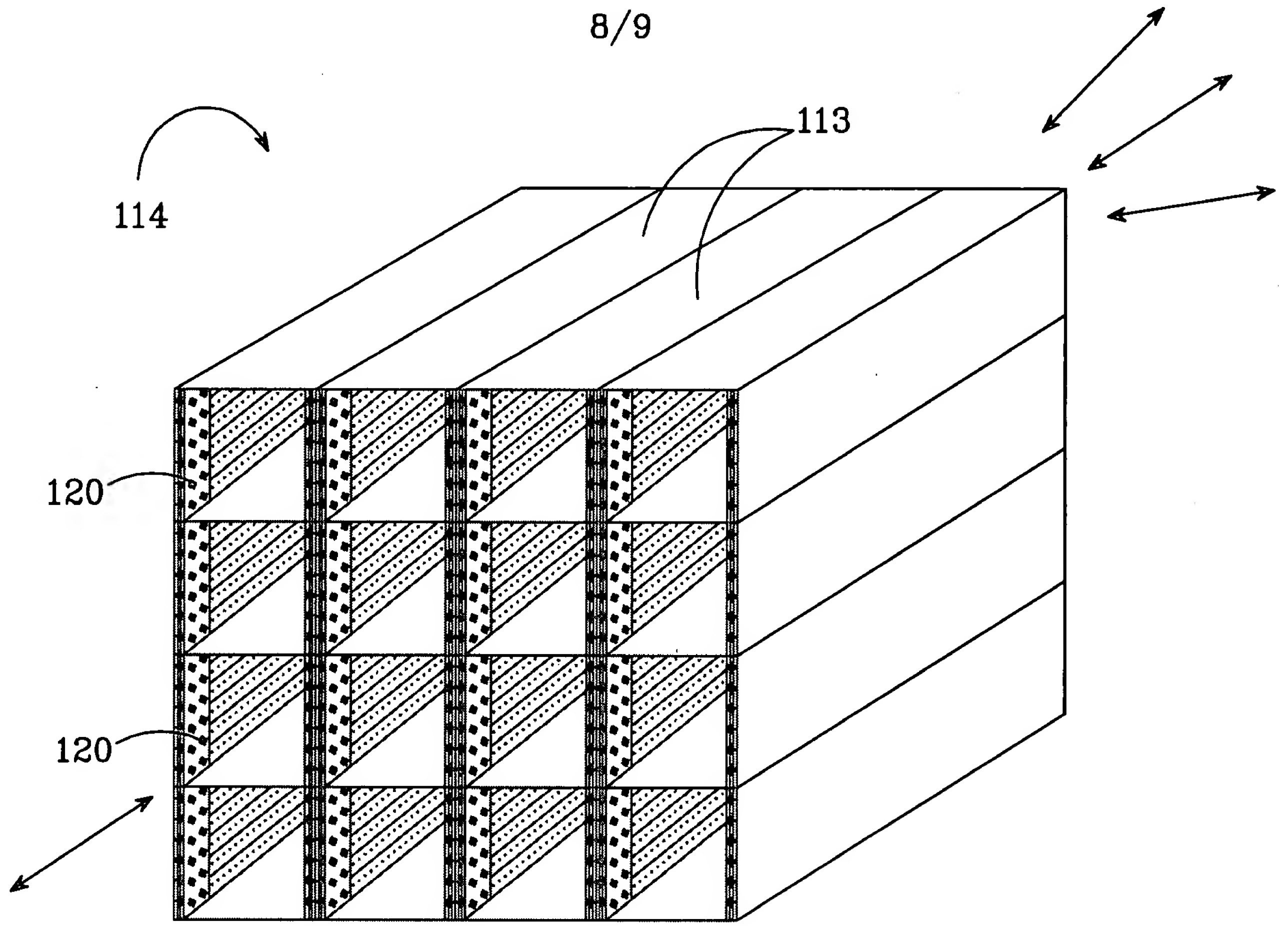

FIG.11

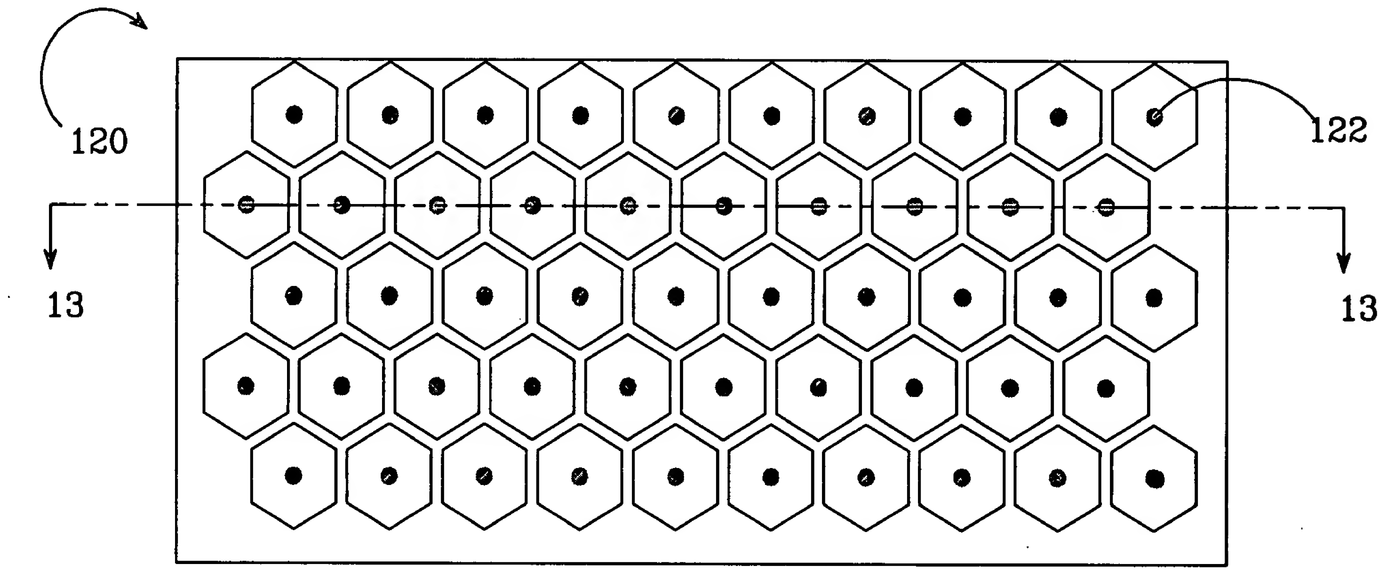

FIG.12

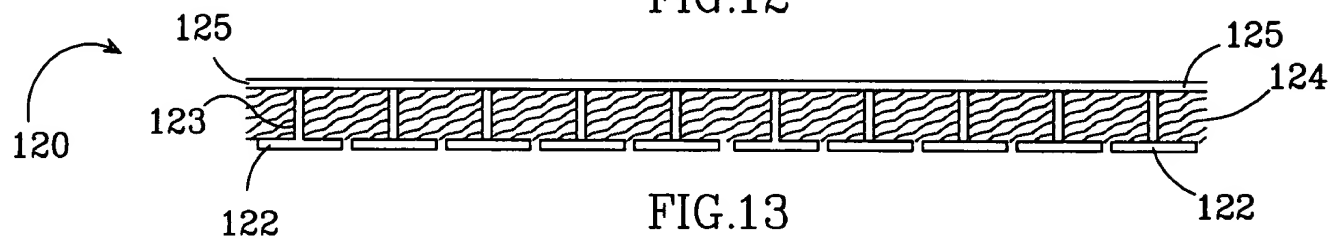

FIG.13